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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In Re PATENT APPLICATION Of:

Applicant: Seiji ANDOH )  
Serial No.: 09/376,063 )  
Filed: August 17, 1999 )  
For: PACKAGE STRUCTURE FOR A )  
SEMICONDUCTOR DEVICE )  
Art Unit: 2835 )  
Examiner: M. Datskovsky )  
Attorney Ref: OKI 226 )

**REPLY BRIEF**

September 10, 2004

**Mail Stop Appeal Brief - Patents**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

This is an Appeal from a Final Office Action mailed on October 22, 2003 regarding the above-referenced application. An Appeal Brief was filed on April 23, 2004 and resubmitted with corrections on June 9, 2004. This Reply Brief on Appeal is being submitted in response to the Examiner's Answer dated July 15, 2004.

The Examiner's Answer recites essentially the same grounds of rejection as those asserted in the Final Office Action. The Applicant/Appellant has responded to those grounds of rejection in the Appeal Brief. Therefore, this Reply Brief will focus on and reply to the Examiner's Response to Argument section (11) at pages 5-8 of the Answer.

In his rebuttal arguments, the Examiner begins by observing that the Appellant

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claims a semiconductor device having a plurality of separate solder bumps grouped distinctly in the signal peripheral area and in the heat transferring central area. The Examiner notes, in particular, that the appellant does not claim a unitary heat transferring body made of the group of solder bumps and heat transfer area as part of the claimed structure. Instead, the solder bumps and heat transfer area are claimed as being placed close enough to be melted together upon application of a heat treatment (see, for example, claim 26). The Examiner asserts that none of the important aspects of this technological process, such as size of the solder bumps, type of solder, temperature and length of the heat treatment, has been claimed or explained in the specification.

The Appellant respectfully disagrees. The range of diameters and spacing of the solder bumps in the heat transfer area appropriate for forming a unitary solder mass is in fact described in the application at page 5, lines 23-28. This range is expressly reflected in claim 31.

More significantly, the Examiner argues at a later point in his rebuttal that the technology of solder ball connections is well-known in the art, and it would be obvious that melting the heat transmitting balls together could be achieved by manipulating the sizes of the balls and/or the distances between them. The Examiner also later quotes with approval a statement made by the Appellant in a previous communication that "in this case, a person of ordinary skill in the art could readily determine what spacing, or range of spacings, of the bumps in the first bump unit would be sufficiently close such that the bumps would fuse into a unitary body upon application of the heat treatment." These statements by the Examiner are clearly inconsistent with his initial assertion that Appellant has not provided sufficient information in the application to support the claimed structure, i.e., bumps in the

first bump unit that are sufficiently close to each other that upon application of the heat treatment to the device, the bumps of the first bump unit fuse into a unitary body.

The Examiner points in his rebuttal arguments to Bond et al. as teaching a semiconductor device 8, Figures 1-6, also having two distinct groups of separate solder bumps 18: one in the signal, peripheral area and another in the heat transferring, central area. The Examiner asserts that in discussing the figures of the Bond et al. reference in the Appeal Brief, Appellant omitted Figure 2, which clearly shows solder balls 18 located in the central, heat transfer area without any distance between them, which makes it obvious enough, according to the Examiner, to conclude that upon applying heat they would definitely melted together. The Examiner also notes that on the same Figure 2, the signal solder bumps are shown located distinctly apart from the central group of pumps, undoubtedly construing Figure 2 to show the claimed feature "a distinct intermediate area in which no bumps are disposed."

The Examiner places great reliance on Figure 2 of Bond et al. Figure 2 is an overall plan view showing the semiconductor device 8 already attached to system circuit board 20 (Bond et al. column 3, lines 49-51). However, it is known that patent drawings are often lacking in detail and often not to scale, and Appellant believes it is unwarranted to conclude on the basis of Figure 2 alone that the bumps in the central area under conductive slab 12 are very close or even touching each other. Figure 1 is a cross-section of the same embodiment along sectional line 1-1 (column 3, lines 46-49) in the immediate vicinity of the semiconductor device 8, and reveals far more detail than Figure 2. Figure 1 shows that solder balls 18 under the conductive slab 12 are not in contact with each other, and in fact, do not appear to be any closer to each other than the solder balls in the peripheral area.

Perusal of the other figures in Bond et al. also fails to disclose any embodiment in which the solder balls in the central area are touching each other or fuse together after the reflow process (see particularly Figure 6). Contrary to the Examiner's position, it is submitted that when the reference is considered as a whole, it is not obvious that the solder balls under the central area of the semiconductor device in Bond et al. would fuse together when heated to form a unitary mass.

In his rebuttal arguments, the Examiner disagrees with Appellant's statement in the Appeal Brief that "the difference between the claimed invention and the reference by Bond et al. is not a matter of degree, but rather one of kind." The Examiner asserts that, on the contrary, both devices are substantially similar semiconductor packages having similar packaging, electronic and cooling designs, such that the difference is not even a matter of degree.

Interestingly, the Examiner admits that Bond et al. do not claim certain relationships between distances between groups of solder balls and the solder balls themselves, apparently referring to limitations in the claims of the present invention that are directed to the relationship among the distance between bumps in the central area, the distance between bumps in the peripheral area, and the distance between the central area and the peripheral area (see, for example, claim 20). Rather, the Examiner relies on his interpretation of Figure 2, discussed above, and on the allegedly well-known technology of solder ball connections which teaches avoiding shorting between solder balls during the reflow (heating) process by manipulating the sizes the sizes of the balls and/or the distance between them. The Examiner argues that it would be obvious to conclude that in the device by Bond et al. an entirely opposite result, i.e. melting the solder balls together, could also be achieved by manipulating

sizes of the heat transmitting solder balls and/or the distances between them. In the Examiner's view, that is what was done in Bond et al. in order to prevent the signal solder bumps for shorting between themselves and with the heat transfer solder bumps.

The Examiner's argument ignores the fact, discussed above, that Bond et al. totally fails to disclose any melting together of the solder bumps in the central area under the conductive slab 12 during the reflow process used to mount the semiconductor device 18 to the main circuit board 20. This feature is neither referred to in the text nor shown in the figures. In fact, Bond et al. teaches away for any such fusion of the solder balls in the central area during reflow. Figure 6 shows that Bond et al. employs a solder mask 81 (Figure 5) under conductive slug 72 to define and limit the shape of the resulting solder leads 80' (column 7, lines 35-39).

The other prior art that has been previously applied in this case by the Examiner is similarly lacking in any teaching or suggestion regarding this key feature. For example, Katchmar (U.S. Patent No. 6,194,782 B1), which was mentioned in the Appeal Brief, discloses in one embodiment (Figure 5), the use of solder balls arranged in close proximity to each other under the semiconductor chip (die) 18 in the central area. However, Katchmar fails to teach or suggest that the solder balls in this embodiment are melted and fused together to form a unitary body as a result of heat treatment during the mounting process, as claims 26 and 28 require. Katchmar also discloses in another embodiment (Figure 4) the use of a single central solder mass 26 that bonds during the reflow process to both the solderable pad 32 on the bottom surface 16 of the package substrate 12 and the solderable pad 34 on the top surface 30 of the printed circuit 28. The first-mentioned embodiment is fabricated with solder balls under the central area that retain their individual

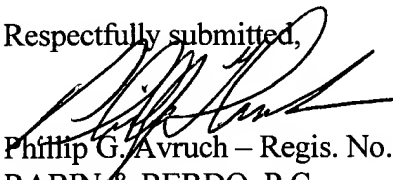
identity after heat treatment, and the second-mentioned embodiment starts with a single central solder mass that similarly retains its character after heat treatment. There is simply no suggestion in Katchmar to modify the first-mentioned embodiment to replicate the results of the second mentioned embodiment.

Under applicable law, as cited in the Appeal Brief (page 13), the issue is not whether it is within the skill of the artisan to make the proposed modification but, rather, whether a person of ordinary skill in the art, upon consideration of the references, would have found it obvious to do so. The fact that the prior art could be modified so as to result in the combination defined by the claims would not have made the modification obvious unless the prior art suggests the desirability of the modification. It is the Appellant's position that neither Bond et al. nor any of the other prior art relied upon by the Examiner suggest the desirability of the feature of having bumps in the first bump unit that are sufficiently close to each other that upon application of the heat treatment to the device, the bumps of the first bump unit fuse into a unitary body.

For the reasons set forth in the Appeal Brief and this Reply Brief, it is submitted that the rejection of claims 20, 22, 24-29 and 31 under 35 U.S.C. §103(a) as obvious over Bond et al., U.S. Patent No. 5,642,261, is in error. Reversal is clearly in order and is again respectfully requested.

Date: September 10, 2004

Respectfully submitted,

  
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